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Gamma-Ray Pulsar Light Curves in Offset Polar Cap Geometry

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Recent studies have shown that gamma-ray pulsar light curves are very sensitive to the geometry of the pulsar magnetic field. Pulsar magnetic field geometries, such as the retarded vacuum dipole and force-free magnetospheres, used to model high-energy light curves have distorted polar caps that are offset from the magnetic axis in the direction opposite to rotation. Since this effect is due to the sweepback of field lines near the light cylinder, offset polar caps are a generic property of pulsar magnetospheres and their effects should be included in gamma-ray pulsar light curve modeling. In slot gap models (having two-pole caustic geometry), the offset polar caps cause a strong azimuthal asymmetry of the particle acceleration around the magnetic axis. We have studied the effect of the offset polar caps in both retarded vacuum dipole and force-free geometry on the model high-energy pulse profiles. We find that, compared to the profiles derived from symmetric caps, the flux in the pulse peaks, which are caustics formed along the trailing magnetic field lines, increases significantly relative to the off-peak emission, formed along leading field lines. The enhanced contrast produces greatly improved slot gap model fits to Fermi pulsar light curves like Vela, which show very little off-peak emission.